

**Health Consultation  
Final Version**

**J.H. Baxter and Company  
Eugene, Lane County, Oregon**

**CERCLIS # ORD009032400**

Prepared by the  
Superfund Health Investigation and Education Program  
Oregon Department of Human Services  
Under a cooperative agreement with the  
Agency for Toxic Substances and Disease Registry  
U.S. Department of Health and Human Services

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## Purpose and Health Issues

The Superfund Health Investigation and Education (SHINE) program in the Oregon Department of Human Services developed this health consultation to address community concerns about potential air contaminants in neighborhoods near the J.H. Baxter and Company's wood-processing facility in Eugene, Oregon. The health consultation focuses on the wood preservatives used at the site. Because air sampling data is not available, SHINE has classified the site as an indeterminate health hazard. SHINE recommends developing a comprehensive air-monitoring program for the neighborhoods near the site. The data are needed to evaluate whether contaminants in the air and in windblown dust are at levels that could be harmful to people in the area.

## Background

The Superfund Health Investigation and Education (SHINE) program is a part of the Oregon Department of Human Services. SHINE was created in 2001 through a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR) to address human health concerns related to environmental contaminants in Oregon. In October of 2003, in response to an increasing number of requests from persons living near the Baxter site, the Lane Regional Air Pollution Authority asked SHINE to evaluate whether persons living near the Baxter site were at risk of harmful health effects from emissions from the wood-processing operations.

J.H. Baxter and Company is a wood-treatment facility in Eugene, Oregon that has been in operation since 1943. The company is located at 85 North Baxter Road on approximately 42 acres of land (Figure 1). Offices and wood storage and pressure-treatment facilities occupy the site, and a fence topped with barbed wire surrounds the site. Among other wood products, utility poles, cross-arms, railroad ties, and posts are pressure-treated at the site. Substances used at the site to treat the wood include creosote, pentachlorophenol (PCP), and ammoniated copper zinc arsenate (ACZA).

On December 9, 2003, three SHINE staff members and representatives from the Lane Regional Air Pollution Authority and the Lane County Environmental Health Department made a personal visit to the J.H. Baxter site. Accompanied by representatives of the J.H. Baxter Company, they observed the wood-treating and storage facilities.\*

Vapors are released from several sources at the Baxter site. The sources include emissions

1. released when doors to a retort (a steel cylinder in which the wood is treated) are opened after a treatment cycle,
2. released into the air from wood drying after treatment, and
3. released from wood stored on the site.

The air pathways identified as potential sources of exposure to nearby residents include direct exposure to airborne vapors and contaminated windblown dust [1]. Other facilities in the area are

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\* The SHINE staff members visiting the site were Amanda Guay, Dave Stone, and Janice Panichello. The Lane Regional Air Pollution Authority representative was John Morrissey, and Scott Kruger represented the Lane County Environmental Health Department. J.H. Baxter staff included their plant manager, two environmental health and plant safety specialists, and their environmental consultant.

also potential sources of additional emissions. Among these facilities are a sewage treatment plant, a pulp mill, wood-products and recycling plants, coffee-processing plants, a Union Pacific rail yard, and a number of other facilities which emit solvents into the air.

Historically, steam injection of preservatives during wood pressure-treatment processes was a significant source of vapor emissions from J.H. Baxter. In the fall of 2002, J.H. Baxter initiated an odor-abatement project to reduce vapor and odor discharges during pressure-treatment operations. Large capacity vacuum pump systems were installed to condense vapor discharges and to return the preservatives to the wood-treatment process. In addition to these measures, J.H. Baxter developed a method to cool the wood rapidly before opening the retort doors after treatment. This helps to reduce vapors emitted into the air when the doors are opened.

**Figure 1: The J.H. Baxter Site and Surrounding Neighborhood**



Currently, the Oregon Department of Environmental Quality is investigating groundwater and soil contamination at the site. The level of contamination is highest near the wood-treating equipment. Groundwater contamination extends off the site approximately 2,500 feet west and northwest of the plant. As of June 2001, 173 million gallons of groundwater, containing 730 pounds of pentachlorophenol, have been extracted and treated. In 1999, J.H. Baxter removed soil that was contaminated with arsenic from four properties adjacent to the site.

J.H. Baxter is located within the city limits of Eugene, the second most populated city in Oregon. According to data from the 2000 U.S. Census, approximately 1,871 persons live within ½ mile of the site, and 6,852 persons live within 1 mile. Wind direction is predominantly from the north or

northeast during summer, and from the southwest during winter. The areas north, northwest, and west of J.H. Baxter are primarily residential. Industrial areas are located south, west, east, and northeast of the site.

## **Community Concerns**

For several years the Lane Regional Air Pollution Authority has received numerous complaints from residents living near the Baxter site. In 2003 the number of complaints increased significantly from those received in previous years. Complaints have been reported from multiple locations, but more of the complaints come from areas immediately north and northeast of the site. Complaints occur more frequently during the months of July, August, and September.

Three neighborhoods in the area report the most complaints to the Lane Regional Air Pollution Authority: the Bethel area, the Trainsong neighborhood, and the River Road area. The Bethel neighborhood is large, spanning several blocks and extending from Irving Road in the north to Roosevelt Boulevard in the south. The Baxter site is located along Baxter Street and Roosevelt Boulevard, in the southeast corner of the Bethel neighborhood. The Trainsong neighborhood is northeast of the Baxter site and between Highway 99 and the Union Pacific rail yard. The River Road neighborhood is farther northeast of the Baxter site, past the Northwest Expressway and the rail yard. During the site visit, SHINE staff members noted a paved walking trail and a daycare facility and playground near Roosevelt Boulevard.

On December 9, 2003, SHINE hosted a public meeting (a public availability session) to meet with residents from the three neighborhoods. SHINE received more than 50 comment sheets after the meeting, some at the meeting, and some through the mail. A comment mentioned consistently was that the intensity and frequency of odors had increased recently and were most prevalent at night and during the summer. People reported health concerns that included sore throat, eye irritation, headache, nausea, chronic pain, immune system impairment, difficulty in breathing, dizziness, arthritis, allergy and sinus problems, increased skin irritation and sensitivity, endocrine changes, obesity, depression, and elevated rates of acute myelogenous leukemia, a malignant disease of bone marrow. The most common complaints were the presence of noxious odors, headaches, dizziness, nausea, eye irritation, and difficulty in breathing.

## **Data Used**

Using a 1998 production rate of 593,271 cubes of creosote-treated wood, the Lane Regional Air Pollution Authority provided information on estimated emissions data for the J.H. Baxter Company. Fugitive vacuum systems exhaust, retort door, vent, and treated wood storage emissions were 38.47, 104.92, 4,490.12, 4,830.67 and 3,506.23 pounds per year, respectively. In 2002, 744,974 cubes were treated, approximately 25% more than the amount treated in 1998. J.H. Baxter indicated that products treated with creosote increased in 2003 as the number of suppliers had decreased without a lessening of the demand for treated wood (Gary Hunt, J.H. Baxter, personal communication, December 9, 2003).

The Lane Regional Air Pollution Authority permits J.H. Baxter to emit hazardous air pollutants and volatile organic compounds from five retorts. The authority sets production limits of no more than 3,000,000 cubic feet of treated product per year, and J.H. Baxter cannot have more than two retort door openings for creosote and PCP in any 60-minute period.

Currently, no air monitoring exists for the surrounding neighborhood. The lack of air monitoring data is considered a fundamental data gap. The lack of data prevents SHINE from conducting an exposure assessment for the community.

### **Information on the Wood Preservatives used at J.H. Baxter**

The following description of the wood preservatives used at the J.H. Baxter facility is provided to inform the residents of the Bethel, River Road, and Trainsong neighborhoods. These chemicals were selected because of the increasing number of complaints from the residents who identified a “creosote” or “tar-like” smell and “ammonia-like” odors. Some of the symptoms reported by the community are consistent with the health effects associated with these chemicals. However, because of the lack of the air monitoring data, it is not possible to determine whether these chemicals are the cause of the reported symptom and odor complaints.

#### **Pentachlorophenol**

PCP has been heavily used in the United States for utility poles, cross arms, fence posts, and similar products. PCP can also be found in consumer products such as boats, furniture, and log houses, although these uses have been banned since 1984. PCP volatilizes from wood-treated products [2], and off-gassing increases with increasing temperature [3]. These factors increase the possibility for airborne PCP vapors during warmer months, thereby increasing the potential for persons in the area to be exposed through inhalation.

The U.S. Environmental Protection Agency (EPA) estimated that each day the general population inhales 6 micrograms ( $\mu\text{g}$ ) of PCP (1  $\mu\text{g}$  is equal to one millionth of a gram)[4]. Workers at wood treatment plants were estimated to have daily exposures ranging from 0.9 milligrams (mg) to 14 mg PCP (one milligram is equal to one-thousandth of a gram) [4]. Persons who live closer to active sources of PCP emissions could experience higher exposure to PCP vapors than the exposure estimated for the U.S. general population as a whole. Populations who may have a greater-than-average risk of susceptibility to PCP include people working in hot environments if PCP is present at high concentrations, people with a diminished ability to disperse body heat, children, pregnant women, and the elderly, and people who have a poor diet or are malnourished, or who have impaired liver or kidney function.

When it is inhaled, PCP is absorbed by the blood. Chronic inhalation exposure to high levels of PCP could result in inflammation of the upper respiratory tract and bronchitis [6]. The International Agency for Research on Cancer (IARC) has determined that PCP is possibly carcinogenic to humans, and EPA has classified PCP as a probable human carcinogen [5]. The majority of PCP is excreted through the urine and does not accumulate within the body to a significant degree.

Impurities found in PCP formulations include small amounts of dioxin congeners. Dioxins and furans consist of approximately 210 different compounds with different levels of chlorination. PCP typically contains the higher chlorinated dioxins, which tend to have less toxicity compared with other dioxin congeners. Because of inadequate exposure information and simultaneous exposures to other chemicals, human epidemiology studies are not conclusive [7]. One study that examined blood samples from residents living near a wood-treatment facility suggested that elevated dioxin profiles in the blood were compatible with PCP as the source [8].

## **Creosote**

Creosote is a general term used to describe a variety of products made from mixtures of chemicals. Coal tar creosote is widely used as a wood preservative in the United States. Some of the major classes of chemicals found in coal tar creosote, which is derived from the distillation of coal tar, are polycyclic aromatic hydrocarbons (PAHs), phenol, and cresols. Some of the major ingredients in creosote vapor include naphthalene, methylnaphthalene, indene, phenol, toluene, cresols, xylene, and xylenols [1]. Approximately 300 chemicals have been identified in coal tar creosote, but it is thought that as many as 10,000 could be present [1]. Long-term exposure to creosote vapors of sufficient concentration can cause irritation of the respiratory tract [10].

Naphthalene is the largest creosote constituent in the air surrounding a wood treatment facility, and one of the more volatile components from creosote [10]. It has a very low odor threshold (the concentration at which the odor of a chemical can be detected), ranging from 0.0095 parts per million (ppm) to 0.64 ppm [11]. The National Toxicology Program reported clear evidence that naphthalene is carcinogenic in rats [12]. The potential for naphthalene to cause cancer in humans is, however, unknown. Gastrointestinal symptoms, including nausea, vomiting, and abdominal pain, were reported in people who were exposed to 20 parts per billion (ppb) of naphthalene in their homes as a result of the extensive use of mothballs [13]. These symptoms would be less likely to occur from exposure to transient outdoor sources of naphthalene than from sources within the home. Residents living near a creosote-treatment plant in Canada had elevated levels of naphthalene metabolites in their urine compared with control populations [14]. It is not clear whether the elevated levels would result in any adverse health effects.

Polycyclic aromatic hydrocarbons (PAHs) are a group of chemicals that can form during the incomplete combustion or burning of coal, oil, gas, wood, garbage, or other organic substances. PAHs are major components of creosote. PAHs exist in more than 100 different variations, several of which EPA considers probable human carcinogens. Typically, a person is not exposed to an individual PAH, but to a mixture [15]. A study in Canada did not find elevated levels of the PAH pyrene in the urine of residents living near a creosote treatment facility [14].

A number of studies have reported associations between occupational exposure to coal tar creosote and cancer in humans, and the International Agency for Research on Cancer considers creosote to be a probable human carcinogen [16]. Cancer was observed in a number of tissues from animal studies including the respiratory tract, lips and skin, lung, pancreas, kidney, scrotum, prostate, rectum, bladder, and central nervous system [10]. Many of these studies had numerous limitations, including the absence of data on smoking habits and the absence of data on exposures to mixtures of chemicals, which are common at wood treatment facilities and in the general environment. Compared with naphthalene, known carcinogenic PAHs, such as benzo(a)pyrene, are present at much lower concentrations in creosote [17].

## **Arsenic**

Arsenic is a naturally occurring element found throughout Oregon. Inorganic arsenic—the form that is considered most toxic—has known skin, respiratory, nervous system, and carcinogenic effects. J.H. Baxter uses a wood preservative containing ammonia copper zinc arsenate (ACZA) to pressure-treat wood. ACZA consists of 50% copper oxide, 25% zinc oxide, and 25% arsenate (a form of inorganic arsenic). ACZA uses half the arsenic found in traditional preservatives that contain arsenic. Ammonia is used to carry metal ions deep within wood to enhance the wood's longevity.

Several epidemiologic studies have examined the risk of exposure to inhaled arsenic through contaminated dust. Arsenic has known respiratory irritant effects, primarily of the nose, throat, and mucous membranes [18]. Effects on the eyes and skin have been observed in workers exposed to arsenic oxides in the air. In one study, urinary arsenic levels did not differ among persons in control populations and workers exposed to wood preservatives containing arsenic [19]. Increasing evidence from epidemiologic studies indicates that inhalation exposure to arsenic increases the risk of lung cancer [18].

## **Odors**

Some evidence suggests that people can experience symptoms as a result of exposure to odors [20]. Odor-related mechanisms that can result in symptoms include innate odor aversion, stress-induced illness, aversive conditioning phenomena, and aggravation of existing medical conditions, such as bronchial asthma. After exposure to noxious odors, these processes can occur in some individuals and not in others. Smokers and the elderly can be less susceptible to odors. In general, women are more sensitive to smells than men are.

Odor-related aversive conditioning can occur when a person experiences low-level odors after an initial traumatic exposure. A common response is the panic or hyperventilation cluster of symptoms such as fast heart rates, dizziness, nausea, sweating, and anxiety. Stress, which can result in health effects, can to some extent be related to the degree to which an individual believes an odor is causing risk. Many contaminants have odor thresholds that are lower than the levels thought to be hazardous, and can provoke the above-described odor-related symptoms.

Often, the health complaints expressed by a community defy conventional toxicological explanations. This can occur when contaminants are detected below levels associated with known adverse health effects [21]. In addition, a high amount of uncertainty exists concerning the significance of low-level, long-term exposures to contaminants compared with the known health effects of occupational or high dose exposure.

## **Public Review**

This health consultation was available for public review at the Eugene Downtown Library and Bethel branch of the Eugene Library system. The document was released on May 18, 2004 and was available for public comment until July 6, 2004. This document was also available on the web at <http://www.healthoregon.org/superfund>. Comments that were submitted to the Agency for Toxic Substances and Disease Registry, as well as responses to those comments, are included in Appendix A. Comments that included personal medical information, although reviewed by SHINE, but were not included in this document.

## **Conclusions**

1. Currently, because air-monitoring data is not available, SHINE characterizes this site as *an indeterminate public health hazard*. Results of an analysis of air sampling data would allow us to use an objective, standardized approach to evaluate potential exposure levels and assess the risk to health for people in the area.
2. Because people in the area have expressed concerns about acute myelogenous leukemia (AML), SHINE recommends that the Oregon State Cancer Registry work with the community to investigate whether elevated levels of AML are found in the area. While any

association with exposure to low-level contaminants in the air is highly unlikely, to be associated with exposure to low-level contaminants in the air, the possibility of elevated rates of AML should be investigated if the community is concerned.

## **Recommendations**

1. SHINE recommends that the Lane Regional Air Pollution Authority develop and implement a comprehensive air-sampling program in cooperation with interested and involved stakeholders. This program should include monitoring throughout different seasons and at varying times of day. In addition, samples should be collected at various locations, including the neighborhoods surrounding the J.H. Baxter facility.
2. SHINE recommends that the Oregon State Cancer Registry and Department of Human Services work with the community to conduct a cancer cluster investigation for elevated cases of AML in the Bethel, Trainsong, and River Road neighborhoods.

## **Public Health Action Plan**

A public health action plan describes the actions designed to mitigate or prevent adverse human health effects that might result from exposure to hazardous substances associated with site contamination. SHINE will continue to collaborate with appropriate federal, state, and local agencies to pursue the implementation of the recommendations outlined in this document. In addition, SHINE will continue to review any new environmental and health outcome data associated with the J.H. Baxter site, and results of such reviews will be included in future updates of this document as deemed necessary.

Past public health actions conducted by SHINE include providing health education materials related to wood-preservative materials, gathering community health concerns, attending board meetings of the Lane Regional Air Pollution Authority, and hosting a public availability meeting.

The Lane Regional Air Pollution Authority, with the assistance of SHINE, is developing an air-monitoring plan for the neighborhoods surrounding J.H. Baxter. SHINE will assist in the interpretation of the air sampling results to assess the risk to human health through airborne exposure. The data generated from the air monitoring will provide the basis for an updated public health consultation.

SHINE is continuing to provide health education and risk communication services to the community and will host a public availability meeting to present the results of the updated health consultation.

The Oregon Cancer Registry and SHINE are working with the community to determine whether elevated rates of AML exist in the surrounding neighborhoods.

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**Certification**

The Superfund Health Investigation and Education Program of the Oregon Department of Human Services prepared the J.H. Baxter Health Consultation under a cooperative agreement with the Agency for Toxic Substances and Disease Registry. This document is in accordance with approved methodology and procedures.

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I have reviewed this health consultation, as the designated representative of the Agency for Toxic Substances and Disease Registry and concur with its findings.

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## Appendix A: Comments and Responses

Comments submitted by J.H. Baxter & Company, prepared by Toxicology Consultants, Inc.

### Comment Number 1: Creosote Definition and Composition

*Comment:* The SHINE Consultation defines “Creosote” as a general term used to describe a variety of products made from mixtures of chemicals. It is true that the term “creosote” can refer to several very different substances. However, it is also true that different substances, in this case all called creosote, have different toxicities. The Agency for Toxic Substances and Disease Registry (ATSDR), an agency of the U.S. Department of Health and Human Services, fails to distinguish among creosotes derived from vegetation, from combustion of wood or from destructive distillation of coal (ATSDR, 2002). Each of these is quite different in source and composition, and accordingly in toxicity. The relevant creosote in the case of the SHINE consultation is coal tar creosote.

*Response:* The ATSDR does distinguish between toxicities as a resulting from the various forms of creosote. Throughout the “*Toxicological Profile for Creosote (2002)*”, wood creosote and coal tar creosote are distinguished by health effects, use, and physio-chemical properties. Please note the sentence on page 29: “Although beechwood creosote, creosote bush resin, and coal tar creosote have some components in common, such as phenols, the differences in composition are pronounced enough to assume with reasonable certainty that they will have different toxicological properties.” SHINE agrees with the reviewer that the relevant creosote in this consultation is coal tar creosote.

*Comment:* Creosote is not coal tar and is not coal tar pitch. Creosote as used in the wood treating industry is derived from distillation of coal tar and is a complex mixture of variable composition. The specifications for creosotes used in the wood treating industry in North America are established by the American Wood-Preservers Association (AWPA) and are found in AWPA specifications P1/P13 and P2. Both types of creosote, P1/P13 and P2, are used in the North American wood treating industry as wood preservative pesticides. The U.S. Environmental Protection Agency (EPA) regulates the use of creosote as a pesticide in the United States and recognizes AWPA P1/P13 and AWPA P2 as official descriptions of creosotes registered with EPA for use in the wood preservation.

*Response:* SHINE agrees with the reviewer’s comments that creosote is a complex mixture of variable composition, derived from the distillation of coal tar, and that creosote has a different chemical composition from coal tar and coal tar pitch. Under the section entitled “Creosote” SHINE has changed the document to read, “Some of the major classes of chemicals found in coal tar creosote, which is derived from the distillation of coal tar, are polycyclic aromatic hydrocarbons (PAHs), phenol and cresols.” The reference to coal tar pitch (described in the

comment below) has been changed to a reference for creosote. SHINE appreciates the information on AWWA specifications for the North American wood treating industry.

*Comment:* The SHINE Consultation refers (on page 6) to studies of coal tar creosote and cancer in humans and points out that the International Agency for Research on Cancer (IARC) considers coal tar as a known human carcinogen. The reference cited is the International Agency for Research on Cancer Monograph on the Evaluation of the Carcinogenic Risk of Chemicals to Humans, Volume 35. Unlike the SHINE Consultation, Volume 35 of the IARC Monographs correctly presents the distinction between coal tar pitch and coal tar creosote and states that only coal tar pitch is a known human carcinogen. According to IARC, there is only limited evidence that creosote is carcinogenic to humans.

*Response:* Thank you for pointing out the distinction in Volume 35 of the IARC Monographs between the categorization of known and limited carcinogenicity for coal tar and creosote, respectively. IARC considers coal tar creosote to be a probable human carcinogen, given the limited human evidence and sufficient animal evidence. The document has been changed to: "...and creosote is considered to be a probable human carcinogen by the International Agency for Research."

*Comment:* The SHINE Consultation states that the major ingredients of creosote include methyl styrene and cite (incorrectly) Dahlgren et al., Environmental Research 92; 92-98, 2003. The citation in which Dahlgren et al list what they believe to be components of creosote is Dahlgren, et al., Environmental Research, 99-109, 2003. In any case, the Dahlgren work does not include analytical data but instead is a secondary source for a publication by Benedetti, who was actually describing contaminated property near an industrial facility. Creosote does not contain methyl styrene.

*Response:* The citation in the SHINE consultation is correct and taken from Dahlgren et al., Environmental Research 92: 92--98 (please refer to page 98, 3<sup>rd</sup> paragraph which states "Naphthalene, methylnaphthalene, indene, methyl styrene, toluene, xylene, phenol, benzothiophene, diphenyl, acenaphthene, creosols and xylenols are the top 12 ingredients in the vapor phase of creosote"). No reference to the work of Benedetti is made in this paper. Moreover, in research by Heikkila (1987), creosote vapors were collected on XAD2 resin and analyzed by GC/MS. Twelve major components were identified, including methyl-styrene. Because there appears to be controversy about the exact chemical components in the various formulations of wood treatment creosote, methyl styrene has been deleted from the list of chemicals found in creosote vapor in the updated consultation and substituted with xylenols.

## **Comment Number 2 : Creosote Health Effects**

*Comment:* Page 5 of the SHINE Consultation states that long-term exposure to creosote vapors of sufficient concentration can cause irritation of the respiratory tract. No reference or citation is provided with this assertion. The SHINE Consultation cites a reference to occupational exposure to coal tar facilities that produced eye irritation in workers, but the relevance of this to creosote workers (or residents living near a creosote treating plant) is not explained. The description of polyaromatic hydrocarbon induction of cancer on page 6 of the Consultation is so overly broad that it is meaningless in the context of community exposure to wood preservative substances.

*Response:* SHINE has added the reference, “Agency for Toxic Substances and Disease Registry. 2002. Toxicological profile for creosote (update). Atlanta: U.S. Department of Health and Human Services” after the statement that long-term exposure to creosote vapors of sufficient concentration can cause irritation of the respiratory tract (please refer to page 7). Regarding the reference to workers at a coal tar facility, because coal tar and creosote share many chemical constituents, a study describing eye irritation was noted. However, Nevertheless, the reviewer makes a valid point that the relevance to communities and creosote workers is not explained. This reference has been omitted from the updated consultation. Regarding the description of polyaromatic hydrocarbon induction of cancers as being so “overly broad that it is meaningless in the context of community exposure to wood preservatives,”: one purpose of a health consultation is to provide a summary of toxicological information to the community, including the carcinogenic potential for the contaminants of concern. As PAHs are major constituents of creosote and associated with numerous cancers, this statement has been included in the updated public health consultation.

*Comment:* There are no definitive modern studies linking creosote exposure to cancers or other chronic health effects among workers and the public. There is no evidence that incidental contact with creosote can result in any negative health effect. The potential negative health effect of exposure to any product (including creosote) depends upon the extent and duration of a person’s exposure to that product. Without an exposure, there can be no health effect. In addition, some exposures are so insignificant as to be inconsequential.

*Response:* SHINE respectfully disagrees. Numerous papers, including references from 2003 and those reporting results from population-based studies, are cited throughout the consultation. While the extent and duration of exposure to a chemical are critical factors that influence the potential for a negative health effect, they are not the only considerations to take into account. The timing of exposure is a critical factor for developmental toxins, with many substances exerting their most profound effect in critical windows of development. In addition, the nature of the chemical profoundly influences the possibility of a health effect, such as the nonmonotonic dose-response curves observed with some chemicals. Furthermore, some individuals are more susceptible to a given toxin for a variety of mechanisms, including pre-existing medical conditions, allergic-sensitivity responses, and genetic differences. SHINE agrees with the reviewer that without an exposure there can be no health effect, and that some exposures are so

insignificant as to be inconsequential. Unfortunately, due to a lack of air monitoring data, SHINE was unable to assess these possibilities due to a lack of air monitoring data.

*Comment:* Most people rarely, if ever, come into direct contact with creosote. For the vast majority of the population, exposure to creosote is incidental, and infrequent. There do not appear to be any peer-reviewed, published studies which attribute any health effect to the type of infrequent, incidental creosote exposure experienced by most people. There is no evidence in the scientific literature that low levels of creosote or related products in air, soils, sediments, groundwater, surface water or drinking water has ever caused cancer or any other fatal or non-fatal disease in humans.

*Response:* Regarding the reviewer's statement that "there do not appear to be any peer-reviewed, published studies which attribute any health effect to the type of infrequent, incidental creosote exposure experienced by most people," please refer to the published studies by Dahlgren et al. (2003) in the peer-reviewed journal, *Environmental Research*. The ability to make evidence-based, causal relationships between low-level, chronic exposures to airborne chemicals and cancer or health effect outcomes is extremely difficult, given the methodological limitations of sampling, epidemiological techniques, and other factors. Furthermore, there are no reporting mechanisms for medical practitioners for chemical exposures in Oregon beyond lead and acute pesticide poisonings. Established in 1996, the Oregon State Cancer Registry, established in 1996, records cancer incidence by type of cancer and not by suspected cause. Chronic effects often take years to develop and correlating the cause of the adverse health outcome with exposure is often impossible. Given these limitations, scientists often rely on sampling data and risk assessment to determine whether chemicals exceed screening and health-based guidelines. The mandate of a public health organization is to use conservative, protective standards so that the possibility of adverse health outcomes is diminished.

*Comment:* Short-term dermal exposures to high levels of creosote can result in sun-sensitivity or reddening or blistering of the skin, as well as irritation of the eyes or respiratory tract. Few people have such exposures, however, and the conditions caused by such exposures are transitory.

*Response:* SHINE agrees that exposure to creosote can have a reversible effect on the skin, eyes, and respiratory tract. Whether or not these exposures are infrequent would depend on many factors specific to the site and to the individual of concern.

*Comment:* Unlike the general public, workers in wood-treating plants do have the potential for regular exposure to creosote. Over the past 140 years, isolated case reports have been published which purport to link creosote exposure to skin cancer and occasionally to other cancers, or other non-cancer conditions such as skin eruptions. As these were reports of isolated cases, however, they did not indicate whether the incidence of the reported conditions among wood-treating

workers was any greater than in the general population. Moreover, these case reports did not reflect modern working conditions.

*Response:* SHINE disagrees that there is no potential for the general public to have regular exposure to creosote. While the frequency and level of exposure to workers at wood treatment facilities is expected to be the highest among any segment of the population, the general public could be exposed to creosote by breathing vapor emissions from nearby facilities or coming into contact with creosote -treated structures.

*Comment:* Occupational health studies, which included a medical history for subjective symptoms, have been completed on creosote-exposed workers. These occupational health studies are valuable because they not only assess the overall health of the members of the study but also provide an indication of the potential of adverse health effects in all people exposed to creosote. The rationale is that if workers who receive the highest levels of exposure do not demonstrate adverse health effects, then other individuals with much lower levels of exposure also should not experience adverse health effects. Two studies of workers who use creosote to treat wood were undertaken to identify any health problems related to occupational exposure to creosote (Unpublished Study, 1979, 1980). The researchers found little evidence of occupational disease. The only clinical finding thought to result from occupation exposure was the presence of a type of skin rash (pustular folliculitis) found in the interior thigh of a small percentage (<5%) of the workers. Since the time of these studies work practices at creosote wood treating plants are in place to better protect against skin exposure to creosote.

*Response:* SHINE agrees that occupational health studies are valuable. Whether or not they provide an adequate indication of the potential of adverse health effects in all people is debatable. Healthy workers, capable of performing manual labor, are not good surrogates for infants, pregnant women, the elderly, immunocompromised individuals, or other sensitive populations. As the studies referred to were unpublished and not peer-reviewed, SHINE has not had an opportunity to review them.

*Comment:* More recently, epidemiologists have attempted to determine whether people who are occupationally exposed to creosote are at a greater risk than the general population for certain cancers. Studies conducted in Norway and Sweden (Eriksson and Karlsson, 1992; Karlehagen, 1992) and in the United States (Blair, 1993) failed to demonstrate a causal association between occupation creosote exposure and any cancers. One of the studies suggested an association with skin cancers, but the authors admitted that these conditions could have been caused by other exposures, including sunlight (Karlehagen, 1992). The advent of modern working practices has further reduced worker exposure to creosote, and with it the risk of adverse health effects.

*Response:* As stated above, the ability of epidemiological studies to establish causal associations as opposed to correlational associations is limited. Many epidemiological studies determine incidence rates and standardized ratios to determine whether a health risk exists. In the Karlehagen study mentioned above, a significant increase in nonmelanoma skin cancer (standardized incidence ratio = 2.37) and an increase in lip cancer was noted among workers as

compared with the general population. Most epidemiological studies have confounders for many factors, such as sunlight, smoking, diet, and more. These confounders suggest that workers are exposed to many harmful agents, but do not preclude the potential for adverse health outcomes as a result of creosote exposure. SHINE acknowledges the role of confounders in the health consultation, stating “Many of these studies had numerous limitations, including the absence of data on smoking habits and the absence of data on exposures to mixtures of chemicals, which are common at wood treatment facilities and in the general environment.”

*Comment:* Creosote has been used to treat wood in this country and around the world for 140 years. During this time, thousands of people have been occupationally exposed to creosote. Given what we know generally about historical industrial practices, it is likely that worker exposures in the last century and the first half of this century were greater than they are today or have been recently. Despite these occupational exposures over many decades, however, there is still no solid epidemiological proof that creosote exposure causes any chronic health effects.

*Response:* See responses above regarding the limitations inherent in studies of chronic effects from low-level exposure, reporting mechanisms and epidemiological conclusions. Furthermore, epidemiology, similar to other scientific endeavors, cannot “prove” anything. Statistical significance, association, weight-of-evidence and correlation are the metrics used in these studies.

### **Comment Number 3: Worker Exposure Studies**

*Comment:* As expressed above, if workers who receive the highest levels of exposure do not demonstrate adverse health effects, then other individuals with much lower levels of exposure also should not experience adverse health effects. This rationale can be applied to creosote exposure at a wood treating plant vis-à-vis community exposure. Data exist for airborne exposure of workers to creosote at wood treating plants. A study was recently completed that determined the dermal and inhalation exposure creosote workers receive when engaged in wood preservation with creosote (Unpublished Study 2001). Four facilities in North America were studied for 5 days each.

Air samples were collected on PFTE filters and XAD-2 resin and analyzed by a gas chromatograph equipped with a flame ionization detector for individual components of creosote and for coal tar pitch volatiles (CTPV). Dermal sampling was conducted with whole body dosimeters (WBD) which are cotton long underwear worn under regular work clothing and glove liners worn under gloves. Analysis of WBD sample was performed by a gas chromatograph with a mass spectrometer detector. The results of the study indicated that benzene, phenol and cresols were not detectable in the area or personnel samples at any plant site. Airborne naphthalene was measured at each site and average concentrations ranged from 0.08 (0.01 ppm) to 1.29 mg/m<sup>3</sup> (0.25 ppm). The American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Value (TLV) for occupational naphthalene exposures is 52 mg/m<sup>3</sup> (10 ppm). Coal Tar Pitch Volatiles (CPTV) was detected in only one of 88 worker samples, and was below the OSHA CPTV Standard of 0.2 mg/m<sup>3</sup>. The benzo(a)pyrene concentration would be a fraction of the CTPV concentration, or about the standard urban background levels of 0.01-0.02 ug/m<sup>3</sup>.

These occupational exposure data collected at the level of the treating cylinder provide reassurance that community levels of creosote components are at air concentrations unlikely to produce adverse health effects.

*Response:* SHINE has not reviewed this study, as it is unpublished. The information provided by the reviewer is appreciated. The airborne naphthalene levels mentioned by the reviewer could be below occupational standards developed by the ACGIH and OSHA. However, SHINE, however, evaluated the public health implications of exposure to chemicals to the community and not workplace exposures. The comparison value for air contaminants developed by the Agency for Toxic Substances and Disease Registry cite a minimum risk level (MRL) of 2 ppb naphthalene for chronic inhalation exposure. SHINE recognizes that the levels of naphthalene would decrease with distance from treating cylinders. For the residents near the J.H. Baxter facility, the best indicator of how much naphthalene may be present in their air is air-monitoring data taken from their neighborhoods.

#### **Comment Number 4: Naphthalene and Odor**

*Comment:* Because of its distinctive odor, naphthalene, a component of creosote, is often considered to be a marker compound for creosote odor and for creosote presence in the air. The SHINE Consultation suggest that the public who live in the vicinity of creosote plants or happen to be near creosote-treated wood and can smell naphthalene are being overexposed to creosote. Dr. William Cain of the University of California, San Diego, recently measured the human odor threshold for naphthalene and the eye and nasal sensory irritation thresholds for naphthalene. He reports that the odor threshold for naphthalene is below 3 ppb and the ocular and nasal irritation response thresholds are 88 and 90 ppm, respectively (Medeiros, 2001). The Agency for Toxic Substances and Disease Registry (ATSDR) Toxicology Profile for Naphthalene chronic inhalation minimum risk level (MRL) is 2 ppb. This means that the ATSDR MRL for chronic exposure will not be exceeded by the detection of naphthalene odor and that the odor detection threshold for naphthalene is well below the sensory irritation thresholds.

*Response:* SHINE disagrees that our consultation suggests, “that the public who live in the vicinity of creosote plants or happen to be near creosote-treated wood and can smell naphthalene are being overexposed to creosote.” SHINE states that residents living near a wood treatment facility in Canada had elevated levels of naphthalene in their urine and further states that, “It is not clear whether the elevated levels would result in any adverse health effects.” In addition, after citing symptoms reported as a result of exposure to excessive use of mothballs, SHINE states, “These symptoms would be less likely to occur from exposure to transient outdoor sources of naphthalene than from sources within the home.” In our opinion, these statements do not reflect the reviewer’s assertion that SHINE suggests the public is being overexposed.

It appears the reviewer provided an incorrect citation. The reviewer cites Mederios, A.M. et al. (2000), Human Sensory Irritation and Odor Testing on a Complex Aromatic Hydrocarbon, *Toxicological Sciences*, 2000; 54 (1), :190. Page 190 of the reference provided by the reviewer is the eighth page in an article entitled “Development and Modification of a Recombinant Cell Bioassay to Directly Detect Halogenated and Polycyclic Aromatic Hydrocarbons in Serum,” by Ziccardi et al. The reference to Mederios et al. could not be found. SHINE agrees with the reviewer that the detection of naphthalene odor does not imply that levels associated with sensory irritation exist.

#### **Comment Number 5 - : Heikkila Estimations**

*Comment:* The SHINE Consultation cites the Heikkila publication for information about creosote and creosote component levels in air at a wood treating plant (Heikkila, P.R., Harmelia M., Pyy, L. and Raunu, P. Exposure to creosote in the impregnation and handling of impregnated wood, *Scand. J. Work Environ. Health*, 1987; 13:431–437, 1987). Heikkila presents data collected at a number of industrial sites in Finland where creosote is used, but only two wood treating sites. Heikkila’s data may not be representative of creosote exposure in the United States or Canada because the creosote used in Finland is not produced according to the AWWA creosote specifications discussed above. Creosote used in Finland may be produced from coal tar, as it is in the US, or it may be produced from town gas. The industry standard for creosote used in Finland is the British Standard which differs from the AWWA creosote standards. The British Creosote Standard calls for less crystalline or insoluble material in creosote than the AWWA standards and this means that the creosote used in Finland is compositionally different from the creosote used in the U.S. The actual composition of creosote used in the plants Heikkila studied is not given in his paper nor are actual creosote component vapor concentrations given. In the treating plants, Heikkila estimates the naphthalene vapor concentrations to range from 2.2 to 41 mg/m<sup>3</sup>. In the North American study described above the naphthalene concentrations ranged from 0.04-1.29 mg/m<sup>3</sup>. Heikkila did not measure CTPV but reports that a literature value for this parameter in creosote treating plants is 0.07 mg/m<sup>3</sup>. CTPV levels were below the limit of detection in the North American study but could be calculated to be less than 0.00006 mg/m<sup>3</sup>, or substantially below the value Heikkila offered. Benzo(a)pyrene levels were low in the Heikkila study and even lower in the North American study – about at standard urban air levels.

The differences between the Heikkila results of creosote treating plant air sampling and the North American treating plant air sampling study are important because the Consultation suggests that the Heikkila results might establish creosote exposure to the communities.

*Response:* SHINE respectfully disagrees that the reference to Heikkila suggests that their results might establish creosote exposure to the communities of concern in this consultation. The SHINE consultation states, “Naphthalene is the largest creosote constituent in the air surrounding a wood treatment facility and one of the more volatile components from creosote (Heikkila, et al., 1987).” This statement is accurate for wood treatment creosote used in the United States and will be replaced with a reference to the ATSDR Toxicological Profile for creosote. The intent of the reference is to simply highlight a major component of creosote.

**References:**

Heikkila, P.R., Harmelia M., Pyy, L. and Raunu, P. (1987). Exposure to Creosote in the impregnation and handling of impregnated wood. *Scandinavian Journal of Work, Environ Health* 1987;13, pages:431--437.

**Comments submitted by the River Road Community Organization**

*Comment:* We were disappointed about the lack of air monitoring data and thus lack of conclusions that you were able to draw about whether the chemicals emitted by this facility pose a health hazard to residents of our community. However, we appreciate your recommendation that additional air monitoring be done, and the fact that your agency will keep working with LRAPA and other agencies to help get that monitoring accomplished. In addition to short-term air monitoring studies near the plant, we want our West Eugene neighborhoods downwind of the Baxter facility to have a permanent air monitoring station, so that emissions from this and other nearby industrial facilities can be monitored on an ongoing basis. Anything your agency can do to encourage the siting of a permanent air monitoring station in this area would be much appreciated.

*Response:* SHINE is committed to continuing our work with LRAPA, the community, the J.H. Baxter facility and other involved stakeholders. A major part of this work will be to collect and analyze air-monitoring data in the West Eugene neighborhoods. SHINE will convey to LRAPA, the River Road Community Organization concerns to have a permanent air monitoring station in the West Eugene neighborhoods.

*Comment:* In addition to air monitoring, we also want environmental testing (of soil and house dust) at the Baxter facility and in the neighborhoods nearest Baxter. We are especially concerned about the potential for wind or windblown dust to carry and deposit pollutants from the facility into our yards and homes. We also wonder if biomonitoring (testing of blood or urine) could be done as a more direct way to measure the potential exposure of nearby residents to some of the chemicals emitted by Baxter.

*Response:* Numerous soil and other samples have been collected at the J.H. Baxter facility by the Oregon Department of Environmental Quality (DEQ). Limited off-site sampling has occurred in the surrounding neighborhoods. SHINE will relay these concerns to the DEQ project manager for the J.H. Baxter facility. SHINE does not have the resources to conduct biomonitoring of nearby residents. Citizens who want these tests can contact their health provider. From SHINE's perspective, the analysis of air monitoring data would give us an opportunity to determine whether contaminants exist above federal or state health guidelines.

*Comment:* In addition to air pollution, many in our community are concerned about whether groundwater pollution and surface water emissions from the Baxter plant might be affecting our

health or contributing to the overall levels of toxics to which we are being exposed. We would like to see the next phase of your health study address these other sources of potential chemical exposure.

*Response:* Oregon DEQ has conducted groundwater sampling at the J.H. Baxter facility. Contaminants might be found in a media, such as groundwater, but would have no public health implications if there is no exposure pathway. Given the community health concerns and the evaluation by SHINE, the most likely exposure pathway of contaminants found at J.H. Baxter or other nearby facilities is through inhalation.

*Comment:* As far as particular health effects, we are concerned not only about acute myelogenous leukemia (AML), but other cancers, illnesses, and symptoms that might be caused or exacerbated by the chemicals emitted by Baxter. We would like to see the second stage of your agency's health consultation involve a more complete health survey of residents of neighborhoods nearest the Baxter plant, and also investigation of whether any types of cancer are elevated among residents nearest the facility, not just AML.

*Response:* Representatives from the Oregon State Cancer Registry (OSCaR) have been consulted about this issue. They are planning to evaluate the observed-to-expected ratio of some specific types of cancer (i.e., those with a biologically plausible mechanism relative to the pollutants of concern.) to help SHINE to determine whether additional investigation is warranted. SHINE has noted the request for a more complete health survey among residents in an updated health consultation. SHINE has limited staff and budgetary abilities, and numerous sites across Oregon that warrant investigation. To the extent that preliminary data indicate a problem, and our resources allow for it, we will assist in further evaluation of health concerns. That said, however, partnerships with other groups could be a more thorough and efficient approach to surveying the neighborhood.

*Comment:* Finally, we ask that your agency also do consistency checks and independent analysis of the validity of Baxter's reported estimates of their chemical emissions to air and water. If these estimates are used to calculate risks to our community, and to determine legally allowable emissions from the plant, at the least we should have some reassurance that the estimates bear some correlation with reality.

*Response:* SHINE has no authority to do analysis of the validity of Baxter's reported emissions to air and water. This is the role of LRAPA and DEQ, respectively. From SHINE's perspective, the most desirable data would be air monitoring data taken in the neighborhoods, to analyze residential exposure.

*Comment:* Thanks again for your agency's involvement. Many of our neighborhood residents are tired of having to breathe creosote and petroleum fumes in their yards, or to be forced to keep their windows closed on hot summer evenings to avoid the fumes. Frankly, common sense tells us that these chemicals are not good for our health at any level of exposure. We believe that our

state and local agencies should be doing more to protect our health from these continuing, unpleasant and unhealthful fumes.

*Response:* SHINE appreciates the opportunity to work the community and other stakeholders at this site. While SHINE agrees that the chemicals of concern might not be good for you at any level, this does not imply that they are harmful to you at levels below health-based guidelines. SHINE is committed to performing an objective analysis of what public health implications might exist for the West Eugene neighborhoods.

## **Appendix B: ATSDR Glossary of Terms**

The Agency for Toxic Substances and Disease Registry (ATSDR) is a federal public health agency with headquarters in Atlanta, Georgia, and 10 regional offices in the United States. ATSDR's mission is to serve the public by using the best science, taking responsive public health actions, and providing trusted health information to prevent harmful exposures and diseases related to toxic substances. ATSDR is not a regulatory agency, unlike the U.S. Environmental Protection Agency (EPA), which is the federal agency that develops and enforces environmental laws to protect the environment and human health.

This glossary defines words used by ATSDR in communications with the public. It is not a complete dictionary of environmental health terms. If you have questions or comments, call ATSDR's toll-free telephone number, 1-888-422-8737.

### **General Terms**

#### **Absorption**

The process of taking in. For a person or an animal, absorption is the process of a substance getting into the body through the eyes, skin, stomach, intestines, or lungs.

#### **Acute**

Occurring over a short time [compare with [chronic](#)].

#### **Acute exposure**

Contact with a substance that occurs once or for only a short time (up to 14 days) [compare with [intermediate duration exposure](#) and [chronic exposure](#)].

#### **Additive effect**

A biologic response to exposure to multiple substances that equals the sum of responses of all the individual substances added together [compare with [antagonistic effect](#) and [synergistic effect](#)].

#### **Adverse health effect**

A change in body function or cell structure that might lead to disease or health problems

#### **Aerobic**

Requiring oxygen [compare with [anaerobic](#)].

#### **Ambient**

Surrounding (for example, *ambient* air).

#### **Anaerobic**

Requiring the absence of oxygen [compare with [aerobic](#)].

#### **Analyte**

A substance measured in the laboratory. A chemical for which a sample (such as water, air, or

blood) is tested in a laboratory. For example, if the analyte is mercury, the laboratory test will determine the amount of mercury in the sample.

**Analytic epidemiologic study**

A study that evaluates the association between exposure to hazardous substances and disease by testing scientific hypotheses.

**Antagonistic effect**

A biologic response to exposure to multiple substances that is **less** than would be expected if the known effects of the individual substances were added together [compare with [additive effect](#) and [synergistic effect](#)].

**Background level**

An average or expected amount of a substance or radioactive material in a specific environment, or typical amounts of substances that occur naturally in an environment.

**Biodegradation**

Decomposition or breakdown of a substance through the action of microorganisms (such as bacteria or fungi) or other natural physical processes (such as sunlight).

**Biologic indicators of exposure study**

A study that uses (a) [biomedical testing](#) or (b) the measurement of a substance [an [analyte](#)], its [metabolite](#), or another marker of exposure in human body fluids or tissues to confirm human exposure to a hazardous substance [also see [exposure investigation](#)].

**Biologic monitoring**

Measuring hazardous substances in biologic materials (such as blood, hair, urine, or breath) to determine whether exposure has occurred. A blood test for lead is an example of biologic monitoring.

**Biologic uptake**

The transfer of substances from the environment to plants, animals, and humans.

**Biomedical testing**

Testing of persons to find out whether a change in a body function might have occurred because of exposure to a hazardous substance.

**Biota**

Plants and animals in an environment. Some of these plants and animals might be sources of food, clothing, or medicines for people.

**Body burden**

The total amount of a substance in the body. Some substances build up in the body because they are stored in fat or bone or because they leave the body very slowly.

**CAP** [see [Community Assistance Panel](#).]

**Cancer**

Any one of a group of diseases that occur when cells in the body become abnormal and grow or multiply out of control.

**Cancer risk**

A theoretical risk for getting cancer if exposed to a substance every day for 70 years (a lifetime exposure). The true risk might be lower.

**Carcinogen**

A substance that causes cancer.

**Case study**

A medical or epidemiologic evaluation of one person or a small group of people to gather information about specific health conditions and past exposures.

**Case-control study**

A study that compares exposures of people who have a disease or condition (cases) with people who do not have the disease or condition (controls). Exposures that are more common among the cases may be considered as possible risk factors for the disease.

**CAS registry number**

A unique number assigned to a substance or mixture by the [American Chemical Society Abstracts Service](#) EXIT ▶.

**Central nervous system**

The part of the nervous system that consists of the brain and the spinal cord.

**CERCLA** [see [Comprehensive Environmental Response, Compensation, and Liability Act of 1980](#)]

**Chronic**

Occurring over a long time [compare with [acute](#)].

**Chronic exposure**

Contact with a substance that occurs over a long time (more than 1 year) [compare with [acute exposure](#) and [intermediate duration exposure](#)]

**Cluster investigation**

A review of an unusual number, real or perceived, of health events (for example, reports of cancer) grouped together in time and location. Cluster investigations are designed to confirm case reports; determine whether they represent an unusual disease occurrence; and, if possible, explore possible causes and contributing environmental factors.

**Community Assistance Panel (CAP)**

A group of people from a community and from health and environmental agencies who work with ATSDR to resolve issues and problems related to hazardous substances in the community.

CAP members work with ATSDR to gather and review community health concerns, provide information on how people might have been or might now be exposed to hazardous substances, and inform ATSDR on ways to involve the community in its activities.

**Comparison value (CV)**

Calculated concentration of a substance in air, water, food, or soil that is unlikely to cause harmful (adverse) health effects in exposed people. The CV is used as a screening level during the public health assessment process. Substances found in amounts greater than their CVs might be selected for further evaluation in the public health assessment process.

**Completed exposure pathway** [see [exposure pathway](#)].

**Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA)**

CERCLA, also known as Superfund, is the federal law that concerns the removal or cleanup of hazardous substances in the environment and at hazardous waste sites. ATSDR, which was created by CERCLA, is responsible for assessing health issues and supporting public health activities related to hazardous waste sites or other environmental releases of hazardous substances. This law was later amended by the [Superfund Amendments and Reauthorization Act \(SARA\)](#).

**Concentration**

The amount of a substance present in a certain amount of soil, water, air, food, blood, hair, urine, breath, or any other media.

**Contaminant**

A substance that is either present in an environment where it does not belong or is present at levels that might cause harmful (adverse) health effects.

**Delayed health effect**

A disease or an injury that happens as a result of exposures that might have occurred in the past.

**Dermal**

Referring to the skin. For example, dermal absorption means passing through the skin.

**Dermal contact**

Contact with (touching) the skin [see [route of exposure](#)].

**Descriptive epidemiology**

The study of the amount and distribution of a disease in a specified population by person, place, and time.

**Detection limit**

The lowest concentration of a chemical that can reliably be distinguished from a zero concentration.

**Disease prevention**

Measures used to prevent a disease or reduce its severity.

**Disease registry**

A system of ongoing registration of all cases of a particular disease or health condition in a defined population.

**DOD**

United States Department of Defense.

**DOE**

United States Department of Energy.

**Dose (for chemicals that are not radioactive)**

The amount of a substance to which a person is exposed over some time period. Dose is a measurement of exposure. Dose is often expressed as milligram (amount) per kilogram (a measure of body weight) per day (a measure of time) when people eat or drink contaminated water, food, or soil. In general, the greater the dose, the greater the likelihood of an effect. An "exposure dose" is how much of a substance is encountered in the environment. An "absorbed dose" is the amount of a substance that actually got into the body through the eyes, skin, stomach, intestines, or lungs.

**Dose (for radioactive chemicals)**

The radiation dose is the amount of energy from radiation that is actually absorbed by the body. This is not the same as measurements of the amount of radiation in the environment.

**Dose-response relationship**

The relationship between the amount of exposure [[dose](#)] to a substance and the resulting changes in body function or health (response).

**Environmental media**

Soil, water, air, [biota](#) (plants and animals), or any other parts of the environment that can contain contaminants.

**Environmental media and transport mechanism**

Environmental media include water, air, soil, and biota (plants and animals). Transport mechanisms move contaminants from the source to points where human exposure can occur. The environmental media and transport mechanism is the second part of an [exposure pathway](#).

**EPA**

United States Environmental Protection Agency.

**Epidemiologic surveillance** [see [Public health surveillance](#)].

**Epidemiology**

The study of the distribution and determinants of disease or health status in a population; the study of the occurrence and causes of health effects in humans.

**Exposure**

Contact with a substance by swallowing, breathing, or touching the skin or eyes. Exposure may be short-term [[acute exposure](#)], of intermediate duration, or long-term [[chronic exposure](#)].

**Exposure assessment**

The process of finding out how people come into contact with a hazardous substance, how often and for how long they are in contact with the substance, and how much of the substance they are in contact with.

**Exposure-dose reconstruction**

A method of estimating the amount of people's past exposure to hazardous substances. Computer and approximation methods are used when past information is limited, not available, or missing.

**Exposure investigation**

The collection and analysis of site-specific information and biologic tests (when appropriate) to determine whether people have been exposed to hazardous substances.

**Exposure pathway**

The route a substance takes from its source (where it began) to its end point (where it ends), and how people can come into contact with (or get exposed to) it. An exposure pathway has five parts: a source of contamination (such as an abandoned business); an [environmental media and transport mechanism](#) (such as movement through groundwater); a [point of exposure](#) (such as a private well); a [route of exposure](#) (eating, drinking, breathing, or touching), and a [receptor population](#) (people potentially or actually exposed). When all five parts are present, the exposure pathway is termed a completed exposure pathway.

**Exposure registry**

A system of ongoing followup of people who have had documented environmental exposures.

**Feasibility study**

A study by EPA to determine the best way to clean up environmental contamination. A number of factors are considered, including health risk, costs, and what methods will work well.

**Geographic information system (GIS)**

A mapping system that uses computers to collect, store, manipulate, analyze, and display data. For example, GIS can show the concentration of a contaminant within a community in relation to points of reference such as streets and homes.

**Grand rounds**

Training sessions for physicians and other health care providers about health topics.

**Groundwater**

Water beneath the earth's surface in the spaces between soil particles and between rock surfaces [compare with [surface water](#)].

**Half-life ( $t_{1/2}$ )**

The time it takes for half the original amount of a substance to disappear. In the environment, the half-life is the time it takes for half the original amount of a substance to disappear when it is changed to another chemical by bacteria, fungi, sunlight, or other chemical processes. In the human body, the half-life is the time it takes for half the original amount of the substance to disappear, either by being changed to another substance or by leaving the body. In the case of radioactive material, the half life is the amount of time necessary for one half the initial number of radioactive atoms to change or transform into another atom (that is normally not radioactive). After two half lives, 25% of the original number of radioactive atoms remain.

**Hazard**

A source of potential harm from past, current, or future exposures.

**Hazardous Substance Release and Health Effects Database (HazDat)**

The scientific and administrative database system developed by ATSDR to manage data collection, retrieval, and analysis of site-specific information on hazardous substances, community health concerns, and public health activities.

**Hazardous waste**

Potentially harmful substances that have been released or discarded into the environment.

**Health consultation**

A review of available information or collection of new data to respond to a specific health question or request for information about a potential environmental hazard. Health consultations are focused on a specific exposure issue. Health consultations are therefore more limited than a public health assessment, which reviews the exposure potential of each pathway and chemical [compare with [public health assessment](#)].

**Health education**

Programs designed with a community to help it know about health risks and how to reduce these risks.

**Health investigation**

The collection and evaluation of information about the health of community residents. This information is used to describe or count the occurrence of a disease, symptom, or clinical measure and to evaluate the possible association between the occurrence and exposure to hazardous substances.

**Health promotion**

The process of enabling people to increase control over, and to improve, their health.

**Health statistics review**

The analysis of existing health information (i.e., from death certificates, birth defects registries, and cancer registries) to determine if there is excess disease in a specific population, geographic area, and time period. A health statistics review is a descriptive epidemiologic study.

**Indeterminate public health hazard**

The category used in ATSDR's public health assessment documents when a professional judgment about the level of health hazard cannot be made because information critical to such a decision is lacking.

**Incidence**

The number of new cases of disease in a defined population over a specific time period [contrast with [prevalence](#)].

**Ingestion**

The act of swallowing something through eating, drinking, or mouthing objects. A hazardous substance can enter the body this way [see [route of exposure](#)].

**Inhalation**

The act of breathing. A hazardous substance can enter the body this way [see [route of exposure](#)].

**Intermediate duration exposure**

Contact with a substance that occurs for more than 14 days and less than a year [compare with [acute exposure](#) and [chronic exposure](#)].

**In vitro**

In an artificial environment outside a living organism or body. For example, some toxicity testing is done on cell cultures or slices of tissue grown in the laboratory, rather than on a living animal [compare with [in vivo](#)].

**In vivo**

Within a living organism or body. For example, some toxicity testing is done on whole animals, such as rats or mice [compare with [in vitro](#)].

**Lowest-observed-adverse-effect level (LOAEL)**

The lowest tested dose of a substance that has been reported to cause harmful (adverse) health effects in people or animals.

**Medical monitoring**

A set of medical tests and physical exams specifically designed to evaluate whether an individual's exposure could negatively affect that person's health.

**Metabolism**

The conversion or breakdown of a substance from one form to another by a living organism.

**Metabolite**

Any product of [metabolism](#).

**mg/kg**

Milligram per kilogram.

**mg/cm<sup>2</sup>**

Milligram per square centimeter (of a surface).

**mg/m<sup>3</sup>**

Milligram per cubic meter; a measure of the concentration of a chemical in a known volume (a cubic meter) of air, soil, or water.

**Migration**

Moving from one location to another.

**Minimal risk level (MRL)**

An ATSDR estimate of daily human exposure to a hazardous substance at or below which that substance is unlikely to pose a measurable risk of harmful (adverse), noncancerous effects. MRLs are calculated for a route of exposure (inhalation or oral) over a specified time period (acute, intermediate, or chronic). MRLs should not be used as predictors of harmful (adverse) health effects [see [reference dose](#)].

**Morbidity**

State of being ill or diseased. Morbidity is the occurrence of a disease or condition that alters health and quality of life.

**Mortality**

Death. Usually the cause (a specific disease, a condition, or an injury) is stated.

**Mutagen**

A substance that causes mutations (genetic damage).

**Mutation**

A change (damage) to the DNA, genes, or chromosomes of living organisms.

**National Priorities List for Uncontrolled Hazardous Waste Sites (National Priorities List or NPL)**

EPA's list of the most serious uncontrolled or abandoned hazardous waste sites in the United States. The NPL is updated on a regular basis.

**National Toxicology Program (NTP)**

Part of the Department of Health and Human Services. NTP develops and carries out tests to predict whether a chemical will cause harm to humans.

**No apparent public health hazard**

A category used in ATSDR's public health assessments for sites where human exposure to contaminated media might be occurring, might have occurred in the past, or might occur in the future, but where the exposure is not expected to cause any harmful health effects.

**No-observed-adverse-effect level (NOAEL)**

The highest tested dose of a substance that has been reported to have no harmful (adverse) health effects on people or animals.

**No public health hazard**

A category used in ATSDR's public health assessment documents for sites where people have never and will never come into contact with harmful amounts of site-related substances.

**NPL** [see [National Priorities List for Uncontrolled Hazardous Waste Sites](#)]

**Physiologically based pharmacokinetic model (PBPK model)**

A computer model that describes what happens to a chemical in the body. This model describes how the chemical gets into the body, where it goes in the body, how it is changed by the body, and how it leaves the body.

**Pica**

A craving to eat nonfood items, such as dirt, paint chips, and clay. Some children exhibit pica-related behavior.

**Plume**

A volume of a substance that moves from its source to places farther away from the source. Plumes can be described by the volume of air or water they occupy and the direction they move. For example, a plume can be a column of smoke from a chimney or a substance moving with groundwater.

**Point of exposure**

The place where someone can come into contact with a substance present in the environment [see [exposure pathway](#)].

**Population**

A group or number of people living within a specified area or sharing similar characteristics (such as occupation or age).

**Potentially responsible party (PRP)**

A company, government, or person legally responsible for cleaning up the pollution at a hazardous waste site under Superfund. There may be more than one PRP for a particular site.

**ppb**

Parts per billion.

**ppm**

Parts per million.

**Prevalence**

The number of existing disease cases in a defined population during a specific time period [contrast with [incidence](#)].

**Prevalence survey**

The measure of the current level of disease(s) or symptoms and exposures through a questionnaire that collects self-reported information from a defined population.

**Prevention**

Actions that reduce exposure or other risks, keep people from getting sick, or keep disease from getting worse.

**Public availability session**

An informal, drop-by meeting at which community members can meet one-on-one with ATSDR staff members to discuss health and site-related concerns.

**Public comment period**

An opportunity for the public to comment on agency findings or proposed activities contained in draft reports or documents. The public comment period is a limited time period during which comments will be accepted.

**Public health action**

A list of steps to protect public health.

**Public health advisory**

A statement made by ATSDR to EPA or a state regulatory agency that a release of hazardous substances poses an immediate threat to human health. The advisory includes recommended measures to reduce exposure and reduce the threat to human health.

**Public health assessment (PHA)**

An ATSDR document that examines hazardous substances, health outcomes, and community concerns at a hazardous waste site to determine whether people could be harmed from coming into contact with those substances. The PHA also lists actions that need to be taken to protect public health [compare with [health consultation](#)].

**Public health hazard**

A category used in ATSDR's public health assessments for sites that pose a public health hazard because of long-term exposures (greater than 1 year) to sufficiently high levels of hazardous substances or [radionuclides](#) that could result in harmful health effects.

**Public health hazard categories**

Public health hazard categories are statements about whether people could be harmed by conditions present at the site in the past, present, or future. One or more hazard categories might

be appropriate for each site. The five public health hazard categories are [no public health hazard](#), [no apparent public health hazard](#), [indeterminate public health hazard](#), [public health hazard](#), and [urgent public health hazard](#).

**Public health statement**

The first chapter of an ATSDR toxicological profile. The public health statement is a summary written in words that are easy to understand. The public health statement explains how people might be exposed to a specific substance and describes the known health effects of that substance.

**Public health surveillance**

The ongoing, systematic collection, analysis, and interpretation of health data. This activity also involves timely dissemination of the data and use for public health programs.

**Public meeting**

A public forum with community members for communication about a site.

**Radioisotope**

An unstable or radioactive isotope (form) of an element that can change into another element by giving off radiation.

**Radionuclide**

Any radioactive isotope (form) of any element.

**RCRA** [see [Resource Conservation and Recovery Act \(1976, 1984\)](#)]

**Receptor population**

People who could come into contact with hazardous substances [see [exposure pathway](#)].

**Reference dose (RfD)**

An EPA estimate, with uncertainty or safety factors built in, of the daily lifetime dose of a substance that is unlikely to cause harm in humans.

**Registry**

A systematic collection of information on persons exposed to a specific substance or having specific diseases [see [exposure registry](#) and [disease registry](#)].

**Remedial investigation**

The CERCLA process of determining the type and extent of hazardous material contamination at a site.

**Resource Conservation and Recovery Act (1976, 1984) (RCRA)**

This Act regulates management and disposal of hazardous wastes currently generated, treated, stored, disposed of, or distributed.

**RFA**

RCRA Facility Assessment. An assessment required by RCRA to identify potential and actual releases of hazardous chemicals.

**RfD** [see [reference dose](#)]

**Risk**

The probability that something will cause injury or harm.

**Risk reduction**

Actions that can decrease the likelihood that individuals, groups, or communities will experience disease or other health conditions.

**Risk communication**

The exchange of information to increase understanding of health risks.

**Route of exposure**

The way people come into contact with a hazardous substance. Three routes of exposure are breathing [[inhalation](#)], eating or drinking [[ingestion](#)], or contact with the skin [[dermal contact](#)].

**Safety factor** [see [uncertainty factor](#)]

**SARA** [see [Superfund Amendments and Reauthorization Act](#)]

**Sample**

A portion or piece of a whole. A selected subset of a population or subset of whatever is being studied. For example, in a study of people the sample is a number of people chosen from a larger population [see [population](#)]. An environmental sample (for example, a small amount of soil or water) might be collected to measure contamination in the environment at a specific location.

**Sample size**

The number of units chosen from a population or an environment.

**Solvent**

A liquid capable of dissolving or dispersing another substance (for example, acetone or mineral spirits).

**Source of contamination**

The place where a hazardous substance comes from, such as a landfill, waste pond, incinerator, storage tank, or drum. A source of contamination is the first part of an [exposure pathway](#).

**Special populations**

People who might be more sensitive or susceptible to exposure to hazardous substances because of factors such as age, occupation, sex, or behaviors (for example, cigarette smoking). Children, pregnant women, and older people are often considered special populations.

**Stakeholder**

A person, group, or community who has an interest in activities at a hazardous waste site.

**Statistics**

A branch of mathematics that deals with collecting, reviewing, summarizing, and interpreting data or information. Statistics are used to determine whether differences between study groups are meaningful.

**Substance**

A chemical.

**Substance-specific applied research**

A program of research designed to fill important data needs for specific hazardous substances identified in ATSDR's [toxicological profiles](#). Filling these data needs would allow more accurate assessment of human risks from specific substances contaminating the environment. This research might include human studies or laboratory experiments to determine health effects resulting from exposure to a given hazardous substance.

**Superfund** [see [Comprehensive Environmental Response, Compensation, and Liability Act of 1980 \(CERCLA\)](#) and [Superfund Amendments and Reauthorization Act \(SARA\)](#)]

**Superfund Amendments and Reauthorization Act (SARA)**

In 1986, SARA amended the [Comprehensive Environmental Response, Compensation, and Liability Act of 1980 \(CERCLA\)](#) and expanded the health-related responsibilities of ATSDR. CERCLA and SARA direct ATSDR to look into the health effects from substance exposures at hazardous waste sites and to perform activities including health education, health studies, surveillance, health consultations, and toxicological profiles.

**Surface water**

Water on the surface of the earth, such as in lakes, rivers, streams, ponds, and springs [compare with [groundwater](#)].

**Surveillance** [see [public health surveillance](#)]

**Survey**

A systematic collection of information or data. A survey can be conducted to collect information from a group of people or from the environment. Surveys of a group of people can be conducted by telephone, by mail, or in person. Some surveys are done by interviewing a group of people [see [prevalence survey](#)].

**Synergistic effect**

A biologic response to multiple substances where one substance worsens the effect of another substance. The combined effect of the substances acting together is greater than the sum of the effects of the substances acting by themselves [see [additive effect](#) and [antagonistic effect](#)].

**Teratogen**

A substance that causes defects in development between conception and birth. A teratogen is a substance that causes a structural or functional birth defect.

**Toxic agent**

Chemical or physical (for example, radiation, heat, cold, microwaves) agents that, under certain circumstances of exposure, can cause harmful effects to living organisms.

**Toxicological profile**

An ATSDR document that examines, summarizes, and interprets information about a hazardous substance to determine harmful levels of exposure and associated health effects. A toxicological profile also identifies significant gaps in knowledge on the substance and describes areas where further research is needed.

**Toxicology**

The study of the harmful effects of substances on humans or animals.

**Tumor**

An abnormal mass of tissue that results from excessive cell division that is uncontrolled and progressive. Tumors perform no useful body function. Tumors can be either benign (not cancer) or malignant (cancer).

**Uncertainty factor**

Mathematical adjustments for reasons of safety when knowledge is incomplete. For example, factors used in the calculation of doses that are not harmful (adverse) to people. These factors are applied to the [lowest-observed-adverse-effect-level \(LOAEL\)](#) or the [no-observed-adverse-effect-level \(NOAEL\)](#) to derive a [minimal risk level \(MRL\)](#). Uncertainty factors are used to account for variations in people's sensitivity, for differences between animals and humans, and for differences between a LOAEL and a NOAEL. Scientists use uncertainty factors when they have some, but not all, the information from animal or human studies to decide whether an exposure will cause harm to people [also sometimes called a safety factor].

**Urgent public health hazard**

A category used in ATSDR's public health assessments for sites where short-term exposures (less than 1 year) to hazardous substances or conditions could result in harmful health effects that require rapid intervention.

**Volatile organic compounds (VOCs)**

Organic compounds that evaporate readily into the air. VOCs include substances such as benzene, toluene, methylene chloride, and methyl chloroform.

**Other glossaries and dictionaries:**

[Environmental Protection Agency](#) [EXIT](#) ▶

[National Library of Medicine \(NIH\)](#) [EXIT](#) ▶